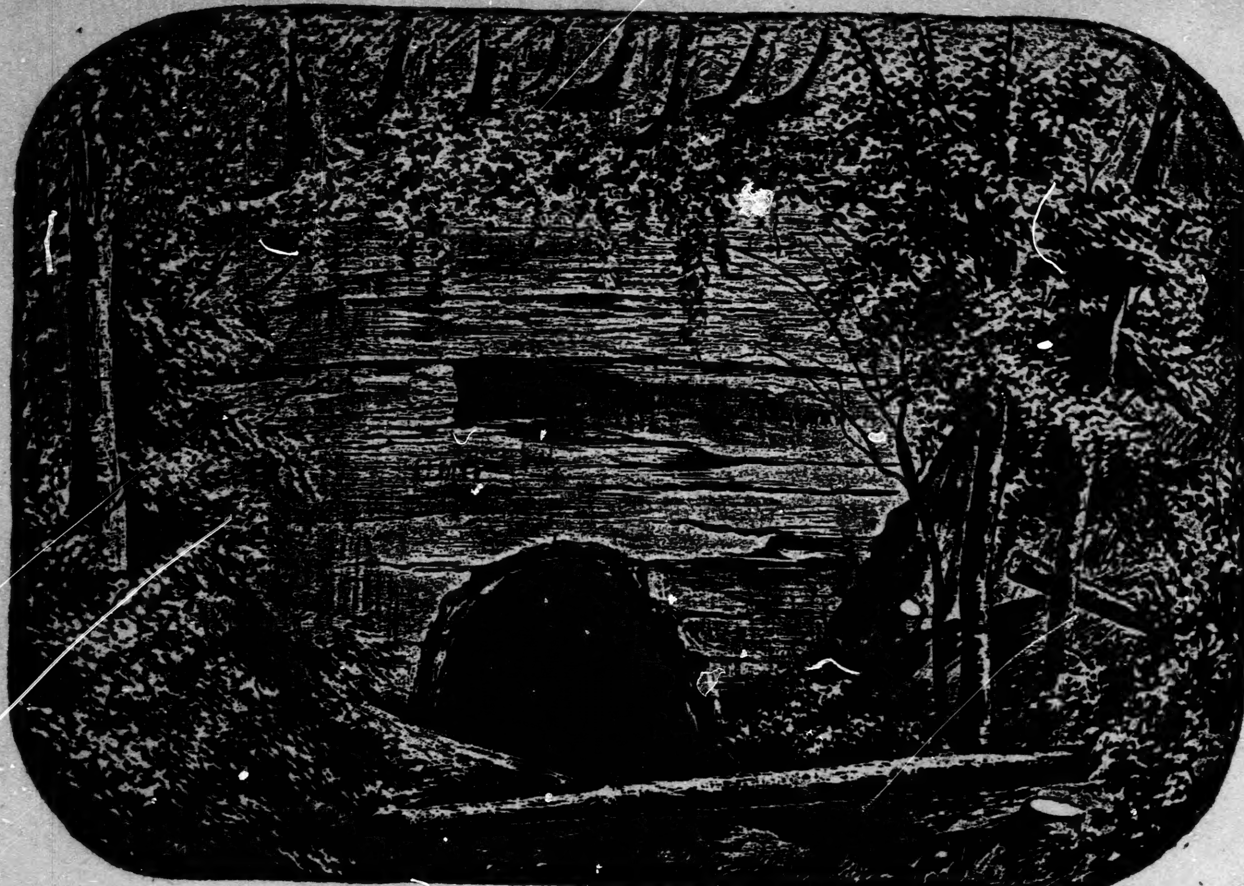
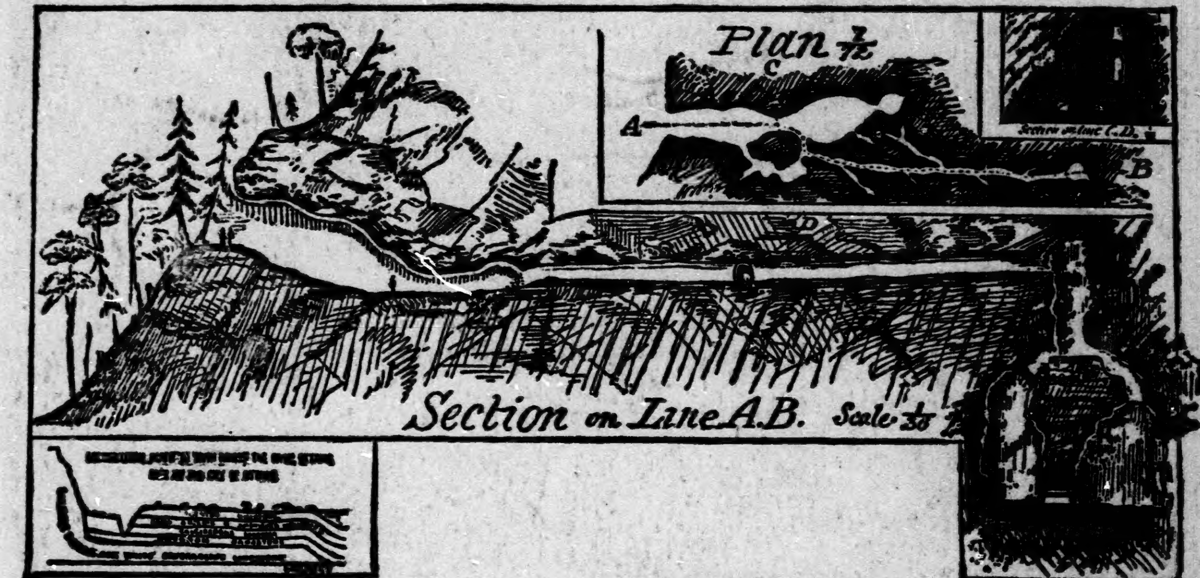


ENTRANCE TO THE WAKEFIELD CAVE.
Leggotyped from Drawing by E. A. Mara.



SECTIONAL VIEW OF THE WAKEFIELD CAVE, ETC.
Leggotyped from Drawings by Rowan and Billings.

ENTRANCE TO THE WAKEFIELD CAVE.
Leggotyped from Drawing by E. A. Mara.

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Paper II.—SUPERFICIAL GEOLOGY OF THE VALLEY OF THE OTTAWA AND THE WAKEFIELD CAVE.

BY J. A. GRANT, M.D., F.G.S., M.P.

(Read before the Society, November 25th, 1868.)

To-night I purpose occupying your attention for a short time by a consideration—first, of the superficial geology of this locality, and secondly, of the Wakefield Cave.

Few parts of the Dominion of Canada are more interesting and attractive, in a geological point, than the surrounding country, taking a view from any tower of the present Parliament Buildings. Here, Upper and Lower Canada of old are seen at once—merely separated by the Ottawa River in its course to the St. Lawrence. On the Hull side, the beautiful Laurentian Hills grace the scene, and in almost every other direction the country presents a level appearance, only occasionally interrupted by moderate and gentle undulations.

So far as the physical history of this country is concerned, it has been erroneously denominated the *New World*. By Agassiz, it is termed, "first-born among the continents, though so much later in culture and civilization than some of more recent birth." "Hers was the first dry land lifted out of the waters, hers the first shore washed by the ocean that enveloped all the earth beside; and while

Europe was represented only by islands rising here and there above the sea, America already stretched an unbroken line of land from Nova Scotia to the Far West."

There are some subjects on which the philosopher is obliged to exercise as much license as the poet. Such is exemplified in the study of geology, a science the direct object of which is to unfold the solid crust of the earth and explain, as far as possible, the agencies at work in the formation and compilation of the Great Stone Book of Nature. The records of this Stone Book can only be perfectly understood by patient and careful observation, and a moderate acquaintance with the most prolific of all languages, the *language of nature.* In the study of geology, every thing has been photographed and preserved for use and reference, in a manner far exceeding in interest the records even of the historian. Each year that passes, brings to light new discoveries in this department of science, and the material yet unknown is so great that it will afford ample opportunity for the development of the intellectual power of man for many years to come.

Nature offers many of her books for our perusal. Every department of such knowledge may be considered a volume. Astronomy supplies not a few, Chemistry many, Zoology and Botany a more than ordinary share. Notwithstanding the attractions of geology, the history of the earth, what it is and how it became so, having as it were wrapped up in its crust the remains of many strange animals and plants, still how few comparatively study this interesting department of science. To understand anything of rocks, we must learn how they have been formed and to thoroughly master this we must observe the nearest approach to such formations at the present day. Such, also, is the case with fossils; for in order to understand them, we require to familiarise ourselves with the plants and animals now living. In all cases where the book of nature is to be studied it matters little where or how that study begins. In every locality there is enough, yes, more than enough, to amuse, suggest thought, interest and instruct.

The limestone foundations now being excavated at the Chaudière, the strangely water-worn formations in almost every direction about the same locality, the pits formed on Sandy Hill, the remains of life exposed to view by the microscope and the naked eye; these are a few of the points of immediate interest, and the various appearances form a part of that hieroglyphic language in which so great a part of nature's stone book is written. There are certain appearances so familiar to every person that they are seldom made the subject of enquiry. By searching out the meaning and object of small and seemingly unimportant changes, the result of the ordinary action of familiar causes and known modes of operation, such as the nature of a deposit of mud, the conversion of mud into stone, the change of stone into some other substance, we learn a history, which forms a key to the history of ages long past. Of the familiar causes of change in the physical appearance of country, moving water and changes of temperature, without doubt, bring about the greatest. Some are occasional, but these are unceasing, operating at all times and in all places. Like influences have produced wonderful changes in our midst, and such as cannot fail to interest and instruct even the most ardent admirer of nature's works. There is, perhaps, no part of the world where the earlier geological records can be studied with greater ease than in both Canada and the United States. On their northern borders are to be seen the low line of hills known as the Laurentian, which rise nowhere more than fifteen hundred or two thousand feet above the level of the sea, and these are the first mountains that broke the uniform plain of the earth's surface, and elevated their heads above the waters. Their low stature, compared with other lofty mountain ranges, is in accordance with the invariable rule by which the age of mountains is estimated. The oldest mountains are the lowest, while those of more recent date are of more gigantic dimensions, and usually present greater indications of force in their formation, such as fractures and dislocations.

Plutonic action has strangely transformed many parts of the

earth's crust. In studying that crust we must free our minds from the idea that it is a solid steadfast foundation. It is constantly heaving and falling, but the oscillations being less regular than the tides of the sea, escape our observation. The ocean is tossed into great billows by the storms, but what are these compared with the forces sufficient to raise such vigorous giants as the Alps, the Himalayas and the Rocky Mountains. Think of mountain ranges rolling up 20,000 feet, lasting monuments of the force by which they were elevated. Such formations are the result of upheavals, and the violence of the outbreak is invariably in proportion to the strength of the resistance. Thus we are enabled to account for the mountain elevations—great and small, on the face of nature. The rocks which compose the crust of the earth are, in general terms, divided into the stratified and unstratified. The former occur in layers or strata parallel to each other, and the latter are devoid of layers, only presenting a massive appearance. These two classes of rocks evidently had a different origin, or in moderate terms, have undergone different influences, the stratified rocks being doubtless of aqueous origin, and the unstratified which present a melted appearance, of igneous origin. The latter may be sub-divided into rocks melted and unstratified at first and rocks changed from the stratified to the unstratified by the re-melting of aqueous rocks, frequently much changed by crystallization, and termed *metamorphic rocks*. The rocks which compose the Laurentian Mountains were shown by the Geological Survey of Canada in 1846, to be a series of metamorphic sedimentary strata, highly crystalline, and underlying the fossil-bearing rocks of this Province,

The rock formations occurring within the limits of Canada, and defined by Sir William Logan, comprise representatives of the Azoic, Lower Palæozoic and Post-tertiary series. The rocks of the Azoic series, are supposed to be formed of sedimentary matters deposited in ancient seas prior to the creation of organic types and subsequently rendered crystalline by metamorphic forces. These have been divided into the *Laurentian* and *Huronian*. The Lau-

rentian rocks consist chiefly of highly crystalline beds of micaceous and hornblendic gneiss, hornblende rock; dolomite and *crystalline limestone*, oxidized iron ores; quartzite and anorthosites, or rocks, as defined by Dr. Hunt, as being largely composed of lime and soda feldspar. In an economic point of view, this formation is chiefly characterized by its extensive beds of iron ore, magnetic and specular, and extensive formations of graphite or plumbago, such as seen in various parts of Hull. The Laurentian formation is of great thickness, over many thousands of feet, and covers an area of over 200,000 square miles, from Labrador northwards. The Huronian formation is chiefly developed along the shore of Lake Huron, and is the higher division of the Azoic series. In it are to be observed chiefly slate conglomerates of a green and greyish color, interstratified with green stone masses, and traversed by numerous trap dykes. It contains quartz veins, holding copper pyrites, and recently extensive discoveries of silver ore have been made near Thunder Bay, now being worked by the Montreal Mining Company. The total thickness of the Huronian formation is considered about 20,000 feet.

Within a short period of time a considerable degree of fresh light has been thrown upon our knowledge of the formations previously considered Azoic, tending very materially to subvert our preconceived ideas of matters and things in general, as to the *Laurentian system of rocks.* Sir William Logan, with that untiring zeal which has ever characterized his labors in connection with the Geological Survey of Canada, travelled over hill and dale in order to confirm his geological diagnosis, of a new formation, of great thickness and lying below those rocks previously described. He has now traced over a tract of country larger than France, a formation consisting of rocks of a highly crystalline character, which, in times past, would have been set down as the *first crust of this earth*, as it parted with its heat, in the transition from plutonic fluidity to its present crystalline state. This formation has so far been defined, as constituting two distinct divisions, the one lying

upon the upturned edges of the other and of vast thickness. It is considered a great stratified belt, shaped out of the waste of rocks formed in a previously undreamt of age. In this crystalline limestone, Sir William Logan discovered the remains of the fossil, designated by Dr. Dawson as the "*Eozone Canadense.*" This opinion is also confirmed by the highest British authority on the microscope, Dr. Carpenter. So far as known, this peculiar fossil is supposed to have grown in masses like the coral reefs of the present day, and is it not a subject of wonder and astonishment when we reflect that the great Laurentian formation of *metamorphic mountain magnitude* rests on a quasi coral reef of *unparalleled extent* and *intense interest?* Thus have we great reason to feel gratified with the result of the combined labors of the able chief of the Dominion Geological Survey and his worthy staff, and more particularly, in so new a country *as Canada.* The stratified formations, as heretofore known and described, are as follows, from below upwards:—Potsdam Sandstone; Calciferous Sand Rock; Birdseye, Black River and Chazy formations; Trenton Limestone; Utica Slate and the drift formation.

POTSDAM SANDSTONE is a term given by the New York geologists to a formation which is well developed at Potsdam, in northern New York, and is there considered as forming the base of the palæozoic series of rocks. Sir William Logan considers this formation as a member of the Potsdam Group. It crosses from St. Lawrence County, New York, into Canada; the greatest development on this side being at the County of Beauharnois. It is said to fill up the inequalities of the underlying Laurentian series. This formation is met with to the eastward, between Lake Chaudière and a spur of Laurentian rock, from three to five miles removed from the right bank of the Lac des Chats, to Nepean, a distance of fully thirty miles. In Nepean the rock dips northward, and thus sinks beneath the calciferous formation. By means of a dislocation, the south side of the band, after leaving the gneiss,

is brought against the Chazy and Trenton formations. The continuation of the dislocation on the south side of the Laurentian spur, accounts for the absence of Potsdam sandstone in that particular position. In the "Geology of Canada" it is here stated as constituting the south side of a synclinal form, on the north side of which it rises in Hull, from beneath the higher members of the Lower Silurian series. In Hull it is observed about five miles north of the Ottawa, and about two miles east of the Gatineau, where it is also brought into view by a dislocation which branches in Osgoode and Gloucester, from the one previously mentioned, and, passing in a direction somewhat west of north, crosses the Ottawa at the Little Chaudière Falls, and shows a downward throw on the east side. According to Professsor Dana, during the first half of the Lower Silurian era, the whole east and west were alike in being covered with the sea, and that in the first or Potsdam period, this continent was just beneath or at the surface. Afterwards, in the Trenton period, the depth became greater, and afforded pure waters for the very abundant marine life.

CALCIFEROUS SAND-ROCK succeeds Potsdam sandstone, and the characteristic portion of this formation, in Canada, is a granular magnesian limestone or dolomite, of a dark bluish-gray color, crystaline, strongly coherent, weathering yellowish brown, and frequently containing small geodes, filled either with calcareous spar, quartz crystals, sulphate of barytes, sulphate of strontia, or sulphate of lime. Its fossils are very imperfect, and in most cases only moulds of these are to be found. In some places the upper part of this formation is of a bluish-gray calcareous argilite. When exposed to the air, it turns yellow or brown, and frequently develops a bituminous odor. The calcareous beds in many districts yield a poor description of lime, and hence the term bastard limestones is applied to them by settlers and others. Calciferous Sand-rock forms part of the great series of strata called the Quebec Group. It is seen along the south shore of the Ottawa in many localities

from Carillon to the Chats. At Aylmer it occurs on both sides of the river, and from the Alumette Island extends south to Prescott, at which point it crosses the St. Lawrence into the United States. A little below Prescott, on the spot where the battle of the Windmill was fought, gentle undulations are to be observed in the strata of this formation, but more particularly on descending the river from Maitland to this point. According to Sir William Logan, the total thickness of this formation is about 300 feet.

Chazy Limestone overlies the Calciferous formation, and derives its name from Chazy, in the State of New York, west of Lake Champlain, where it was first described by the New York geologists. In Canada it is associated with sandstones and shale, and is here described as Chazy formation. It is exposed in the cutting of the Grenville canal, and there crosses the Ottawa to Hawkesbury. In its geographical distribution, it forms a zone around the geological depression between the Ottawa and the St. Lawrence. It forms two patches on the calciferous outlier of the Lac des Chats, also of the lowest outlier of the Alumette Islands. The arenaceous part of the Chazy is seen at Alymer, in Hull, and in the eleventh range of Eardley, on the north side of the Ottawa. It is also found in the Townships of Huntly and Ramsay. The great mass of limestone which overlies the Chazy formation is divided into three portions by the New York geologists. The divisions are supposed to have been characterised by peculiar fossils. However, in Canada, a separation of this kind cannot be definitely carried out, owing to the circumstance that the Birdseye and Black River formations become very indistinct; they are, in consequence, grouped together. Not only are the strata blended together, but the fossils characteristic of the one are also found in the other; thus the difficulty of division. According to Sir William Logan, the Birdseye, Black River, and Trenton formations constitute one of the most persistent and conspicuously marked series of the strata of the Lower Silurian period of North America.

The limestone of the Trenton group is found extensively in Canada East and West, and particularly between the Ottawa and the St. Lawrence, but more especially around the capital of Canada,—Ottawa. The limestones of this locality are affected by two parallel dislocations between five hundred and six hundred yards apart, west of the Rideau. "One of these dislocations comes to the Ottawa a little below the exit of the canal, in a small upthrow to the south; and the other about six hundred yards above it, beyond the Barrack Hill, is a downthrow of seventy feet in the same direction." Farther west this series of limestones come up against the Gloucester and Hull fault, extending from the west side of the junction gore of Gloucester across the Ottawa to the front of the sixth lot of the fifth range of Hull. Owing to these various faults it has been found difficult for the Geological Survey to estimate the thickness of the series in this neighborhood. It is, however, computed that the total volume of the limestones of this locality will not fall short of six hundred feet.

UTICA SLATE (so termed from Utica in the State of New York).—It comprises a series of dark-brown, bituminous shales, interstratified here and there with a few beds of dark limestone. It is found in considerable quantity near this city, and is seen cropping out directly across the Rideau Bridge, near the General Protestant Hospital. In the Townships of Collingwood and Whitby this shale is sufficiently bituminous to produce mineral oil in considerable quantity.

THE DRIFT OR BOULDER FORMATION, of which we have ample evidence in this locality, comes under the Post-pliocene or Post-tertiary period. The clay, sand, and gravel of the valleys of the Ottawa and St. Lawrence, containing sea-shells or the skeletons of marine fish, are also referred to it. Owing to the manner in which drift is supposed to have been formed (that is, transported by ancient

glaciers), it is termed Glacial Drift. "The greatest development and extension of these glaciers is said to have been during the interval between the close of the Cainozoic period and the commencement of the existing epoch, properly so called." It forms the surface of country over a great part of the triangular area included by the St. Lawrence and Ottawa rivers. Stratified clays and sand fill up depressions of great extent over this surface, and erratic boulders of great size are to be observed, in localities the most unexpected. A granitic boulder of considerable magnitude is to be seen just above, and to the right of the Suspension Bridge, on the table of rock lying below; and one on the island immediately above the Chaudière Falls, of much greater size. Dana states that nothing but moving ice could have transported the drift, with its immense boulders. In the glacial regions of the Alps, ice is performing this work at present. In that locality there are evidences of stones of great size, which have, in former times, been borne, by a slow moving glacier from the vicinity of Mont Blanc across the low lands of Switzerland to the slopes of the Jura Mountains, and left there, a height of 2,203 feet above the present level of Lake Geneva. The channel of the Ottawa River is contracted at various parts by ridges of glacial drift, of boulders running north and south. The nearest of these is to be seen above the mouth of Green's Creek, between seven and eight miles below this city. In this locality a well-marked line of boulders runs quite across the river, and forms a considerable obstruction to navigation during low water, such as we have had this season particularly. Professor Dawson divides the eastern post-glacial beds into two series, the lower a deep-sea deposit, named the Leda Clay, from one of its characteristic shells; and the upper, for a similar reason, the Saxicava sand, formed in shallow waters. On the south bank of the Ottawa River, from this city to Hawkesbury, the lower clay formation of Dr. Dawson is to be seen in banks from twenty to forty feet high. "The overlying sand generally approaches the river and conceals the clay except

along the streams." Wherever these clay formations exist along the river the shells *Saxicava rugosa* and *Tellina Grœnlandica* are to be found, and in a bed of clay at Green's Creek nodular masses exist in considerable abundance. The most common fossil embedded in these, is the *Mallotus villosus* or capeling of the Lower St. Lawrence. This capeling is also found in nodules, in clay, on the Chaudière Lake, 183 feet; on the Madawaska at 206 feet; and at Fort Coulonge Lake, at 365 feet above the sea. This formation contains also various other fossils. On the north side of the Ottawa, from Hull to Isle Jesus, this clay formation covers a considerable breadth between the Laurentian Hills and the river. It can also be traced in considerable abundance along the banks of the Gatineau and River Rouge. In the former locality it is well known to the lumberers, who in wet weather describe it as the sticking clay of the Gatineau. A well-defined hill of clay exists on the front and to the left of the General Protestant Hospital, facing the Rideau River, and to the rear an extensive mound of sand, both of which are drift formations. The boulder formation or glacial drift, both in the British Isles and North America, is referred by Lyell to the age of the newer pliocene, of which it marks its close; while the stratified deposits which overlie it, consisting partly of boulder formation re-arranged by water, are placed among Post-tertiary strata. The records of the drift or boulder period extend over North America, north of parallel 40°, as well as over all the northern counties of Europe, and the various boulders have been moved from the north towards the south. Throughout the regions occupied by the drift, the rocks in place are more or less polished, striated, or grooved. These marks are observed on the consolidated formations that appear at the surface, and constitute a very essential part of the records of this period. These sedimentary rocks, the result of aqueous action, are determined by occurring in *beds or strata,* by *exhibiting a sedimentary structure* and *containing the remains of animal organization.*—(*See Plate.*)

Cave.—Cave or cavern is the term adopted to signify a hollow place under ground or rock, and generally having an opening either on the surface or in the brow of a hill or rock, as the case may be. They are usually divided into two classes, the artificial and the natural. Caverns are most usually observed along the courses of rivers and on the coast line of the sea. Such is not unlikely, particularly as the whole stratified system of rocks results from the same denuding and wearing away by water and subsequent hardening of the materials through time. Moving water, carrying with it sand and gravel through rock crevices, by the very attrition, may gradually transform even a small fissure into a cavern. Limestone is the great centre for such excavations, and the largest so far described are the *Caverns of Adelsberg in Carinthia*, on the road from *Vienna to Trieste*, and the *Mammoth Cave of Kentucky*. As objects of curiosity, these two caverns particularly are visited from all parts. Rocks of purely igneous origin frequently contain caverns. An example of such is the picturesque Cave of Fingal, in Staffa, formed in basalt. In South America and in Iceland large caverns have been formed in modern lava. In Canada, such curiosities of nature have not so far attracted any particular attention beyond the brief descriptions of the Geological Survey, and the paper published by Sir Duncan Gibb in 1861, on Canadian Caverns. These number thirty, and are arranged as follows :—

"One in the sandstone of Magdalen Islands; two in the carboniferous formations at Gaspé and Bay of Chaleur; two in the Devonian, Gaspé Bay and Bass Island, Lake Superior; seven in the limestones of the Upper, Middle and Lower Silurian formations.

"*Upper Silurian* :—

Perforations and Caverns of Michilimacinac.
The Old Woman, Cape Gaspé.
Flower Pot Island, Lake Huron.
Mono Cavern.
Eramosa Cavern.
Niagara Caverns.
Subterranean Passages, Manitoulin Island.

"*Middle Silurian*:—

Pillar Sandstone, North Coast of Gaspé.
Bigsby's Cavern, Murray Bay.

"*Lower Silurian*:

Gibb's Cavern, Montreal.
Probable Caverns at Kingston.
Murray's Caverns.
Arched and Flower Pot Rocks, Mingan.
Probable Caverns at Chatham.
The Pictured Rocks, Lake Superior.

"*Huronian Rocks*:

St. Ignatius' Caverns, Lake Superior.
Pilasters of Mammelles, Lake Superior.
Thunder Mountain and Pie Island Pilasters, Lake Superior.

"*Laurentian Rocks*:

The Steinhaver Cavern, Labrador.
Basaltic Caverns of Henley Island.
Empty Basaltic Dykes of Mecattina.
Bouchette's Cavern, Kildare.
Colquhoun's Cavern, Lanark.
Quartz Cavern, Leeds.
Probable Caverns, Iron Island, Lake Nipissing."

To this list may now be added the Wakefield Cave, forming the eighth in Laurentian Rocks, and by far the most interesting and attractive so far explored; being, in fact, the largest cavern in the entire Dominion of Canada.

North from Ottawa, in an almost direct line, *viâ* the Portland Road, distant eighteen miles, on the farm of Mr. Pellessier, is the "*Wakefield Cave.*" It is situated on the side of one of the Laurentian Mountains and faces the north. The mouth of the cave is fully eighteen feet in diameter, of an oval shape, beautifully arched and having overhanging it pine and cedar trees of considerable size. The entire height of the mountain is about 300 feet, and the entrance to the cave is about 100 feet from the summit. At the

base of the mountain is a small lake, which discharges into the Gatineau River through a mountain gorge of exquisite beauty. Looking inwards from the mouth of the cave it is funnel shaped, directed obliquely forwards and downwards a distance of 74 feet, at which point it is contracted to a height of five feet and width of fifteen feet. This contraction forms the entrance to the first "*Grand Chamber*" 80 feet in length, 21 feet across and 9 feet in height throughout. At the posterior part of this chamber, in an oblique direction to the left, is an opening five feet in height, forming the entrance to the third chamber, which is about 18 feet in diameter and 5 feet high. The floor, however, is covered with *calcareous breccia* to a depth of three feet or more. Looking outwards, two openings are to be seen to the left of the first chamber, one anterior, broad and elevated, and one posterior, contracted and shallow, passing obliquely upwards and backwards, a distance of fully 25 feet. This chamber is entirely encrusted with carbonate of lime of a cheesy consistence, and in the centre a perfectly white column reaches from the floor to the ceiling, about six inches in diameter, formed by the union of a stalactite and stalagmite. The antero-lateral chamber passes in an oblique direction upwards, a distance of 30 feet, at which point the ceiling is fully 50 feet high, of a gothic shape and beautifully ornamented with stalactites and fringed like encrustations of carbonate of lime. About 60 feet from the mouth of the cave to the right, is a narrow passage, rough, uneven, and forming the entrance to a chamber the floor of which ascends obliquely upwards a distance of 30 feet, the height of this point being about 50 feet. On the way up a beautiful arch is to be seen, above and beneath which this chamber communicates with the one entered by the antero-lateral opening from the "*Grand Chamber*," and the light reflected from a lamp through the opening below this arch illuminates the entire ceiling of the adjoining chamber and presents a rich appearance as seen through the opening above the arch. To the right of the oblique floor of the antero-lateral

cavity, is an opening, horseshoe shaped, scalloped, about five feet in diameter, and considerably obscured by the overhanging rock. From the body of the cave the passage leading from this opening takes a direction at an angle of about 25° to the right. Its entire length is about 270 feet, height between 4 and 5 feet, and width the same. The floor is rough and covered with small fragments of rock of various sizes and from the ceiling hang many small stalactites. At the inner terminus of this passage is an opening more or less circular, about 20 feet in diameter and the rock over it is concave, and fully 15 feet in height. Stones thrown into this well or cavity give rise to a loud, rumbling noise. Its depth is 37 feet, and the bottom measured 9 feet by 30 feet, on either side of which are two openings, one 5 feet by 12 feet, 22 feet in depth, the other 2 feet by 3 feet and 45 feet in depth. The floors of these lower cavities are covered with fine sand and on every side are to be seen beautiful stalactites. On the right and left of the main passage of this well are to be observed several smaller passages which, from their narrowness, are entered with difficulty. The entire cavern presents a water-worn appearance more or less smooth on the surfaces, of a light gray color, and considerably excavated at intervals. Here and there in each chamber, particularly from the ceilings, are to be seen rough projecting portions of rock of various shapes and composed chiefly of quartzite, pyroxene, serpentine, iron pyrites, and various mineral ingredients peculiar to the Crystaline Laurentian limestone formations. In many parts of the cave, the walls, particularly those to the right of each chamber entered, were covered with moderately uniform sheets of carbonate of lime. The cavern is entered by descending on talus or broken rock; this is succeeded by a floor partly flat, smooth and presenting also a water-worn appearance. Generally speaking, the floor is uneven and strewed with fragments of rock of various sizes, more or less mixed up with broken stalactites and shelved portions of carbonate of lime. The entire cave, excepting the entrance, is perfectly devoid

of light; the atmosphere moist, but exceedingly pure, even to the extent of our explorations, and a uniform temperature of about 45° Fahrenheit. The only organic remains so far discovered were those of the *Vulpes Vulgaris* or common fox, Castor Fiber (Lin) or Beaver, Lutra Vulgaris (Lin) or Otter, and a few drift shells. From the purity of atmosphere in the entire cave, the opinion formed from that fact is, that any accumulating carbonic acid is absorbed by water in some part of the unexplored portion of the cave, and it is not unlikely that parts already visited are only an entrance to vast labyrinths yet to be explored.

In the consideration of this cave, two points of enquiry are suggested; first, what proofs have we of subsidence and elevation of great portions of the earth's surface, and secondly, what facts can be adduced to substantiate the eroding action of water. In the formation of this *British North American Continent* there is nothing particular in either of these respects, nothing more in fact than has been observed in the shaping of continents of *transatlantic notoriety.* Stratified rocks were undoubtedly deposited originally as sediments under water, and owing to the organic remains which they contain the inference drawn is that they were deposited at the sea bottom. Such was exactly the case with the very strata on which this city rests and when that foundation was formed the "Great Silurian Age" flourished. Marvellous then must have been the condition of life, when there were few mountain tops elevated above the level of the vast ocean which covered this continent. As we gather shells, barnacles, starfishes and such like at the sea shore in our summer rambles, so we examine for the remains of molusks, radiates, crinoids, &c., &c., which flourished in the Silurian period of the world's history, in the strata of this neighborhood. From a consideration of these facts one of two things must have taken place, either *the land must have gone up or the sea must have gone down.* Of the latter we have so far no well defined instance, whereas of the former ample and wide-spread evidence exists, such as observed on the *Pacific coast* of South America, where, within

the present century considerable portions of country have been elevated above the sea. So with the northern parts of Sweden and Finland a slow rising is constantly going on, and at the same time the Scandinavian Peninsula towards the south-east shore is sinking. The west coast of Greenland is also gradually sinking, and these changes are brought about without any apparent earthquakes. In Canada there are many fossil-bearing strata hundreds of feet above the present sea level, as seen in our own immediate neighborhood.

After the formation of our stratified rocks it is supposed that this continent, being exposed for an unknown length of time, was again dipped beneath the great oceanic waves, when the present mantle of clays, sand and boulders (termed drift) was thrown over our firm rock foundations. Ansted, of Cambridge, has written, "water is the life of the earth, as blood is the life of man;" and certainly there is ample proof of its extensive operations in the formation of the earth's crust. It is, in fact, the great agent in bringing about the vast circle of changes which form the subject of geological investigation. Judging of what has taken place in our midst, viz., the manner in which the great bed of rock at the *Chaudière* has been cut or channeled out by water; also at Niagara, where the river has cut a channel through the solid rock, 200 feet deep, 1,200 to 2,000 feet wide and fully seven miles long. It is evident that the waters are thus carrying both land and rocks in their course, and the amount yearly transported is truly wonderful. On a small scale we can observe this same action exemplified at the "Gatineau Point," where the land is rapidly being removed. At the mouths of the Mississippi, the Amazon and the Nile, immense deposits of material thus carried, are to be observed as the result of the abading action of water.

Of the Ganges, Sir Charles Lyell says, "that if a fleet of eighty vessels, each freighted with 1,400 tons weight of mud, were to sail down that river every hour of every day and night for four months continuously, it would only transport from the higher regions to

the sea, a quantity of matter equal to that carried by the Ganges in the four months of the flood season." In this same manner many changes have been brought about in the Ottawa and its tributaries. Thus alluvium, drift, and even the solid rock foundations, give way under the eroding action of water. In this same manner water flowing rapidly through the fissured "*Laurentian Mountain Limestone*" has produced the *Wakefield Cave.*

In such formations have we a history pregnant with facts destined to throw light on the Geological Records of this continent. In considering the various facts we are carried back for ages to a time when rocks were fearfully disturbed by volcanic action; when the crust of the earth was folded as paper in the child's hands. Out of the mighty deep rose our Laurentian Hills, and on their foundation was slowly deposited the vast layers of rocks entombing in their very substance the remains of organic life. Thus has a history been handed down, which cannot fail to be an inexhaustible source of enquiry; and, at the same time, fix more indelibly on our minds the accuracy of the sentiment, "*Sermons in stones, books in running brooks, and good in every thing.*"